5

Th-230/U-234 Geochronology of Marine Shells from near Sale, E. Victoria, Australia

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Abstract: Shells from a Quaternary marine bed in Gippsland, Australia, gave a date of 28,800 y BP by ^{14}C, but an average of 101,000 y by U/Th dating.

INTRODUCTION

This report represents the results of U/Th analysis on eight samples of marine shells from west of Lake Melanyara, Sale, E. Victoria, Australia. The samples were collected from the floor of a deep channel north of a drain along a road 1 mile ENE. of Sale by Edmund D. Gill of the National Museum of Victoria. Selection of samples to be analysed and preliminary treatment to remove matrix and other extraneous material was performed by Mr. Gill.

PROCEDURE

In our laboratory, triplicate samples were weighed to the nearest mg and dissolved in 2N HNO_3. To the solution were added a few drops of perchloric acid, 14 mg of Fe (as $Fe(NO_3)_3$) to be used as a carrier, and to two of the samples a known amount of Th-228 and U-232 to be used as yield tracers. This was followed by evaporation to dryness to destroy any organic matter and to insure equilibrium between sample and tracer isotopes. The sample was then dissolved in HCl and precipitated with NH_4OH after which the precipitate was separated from the supernatant liquid by centrifuging. After washing the sample with distilled water and centrifuging again, the precipitate was dissolved in 8N HCl and equilibrated with isopropyl ether to remove the iron. The aqueous solution was then passed through an anion exchange column to effect separation of the uranium from the thorium. Each fraction was then passed through another anion column in 8N HNO_3 for further purification. The samples were mounted on stainless steel planchets by electrodeposition.

The samples were counted by means of alpha spectroscopy in an alpha pulse height analyser system. With this system it is possible to distinguish between each of the three isotopes on each planchet (U-232, U-234, U-238 and Th-228, Th-230, Th-232). The raw data was fed into a computer where corrections for background and contribution of one peak to another were made. The final output listed the concentrations of uranium and thorium, activity ratios of the various isotopes, and the age of each sample.

RESULTS

We feel that the analytical results were extremely good and that the errors are probably conservative.

The data in Table 1 represent the average of the two spiked duplicates. Errors were computed on the basis of counting statistics only. Errors for the calculated ages are the same percentage as for the corresponding Th-230/U-234 ratio. Sample names were supplied by Dr. Norman Weisbord of the FSU Dept. of Geology. The numbering system is the same as supplied by Mr. Gill.

The uranium concentrations for the oyster shells are quite consistent and fall within the range normally exhibited by corals, i.e., 1-3 ppm. The clam shells, however, exhibited unusually high concentrations of uranium indicating possible post-depositional uptake of uranium. With the exception of AS-4 all samples showed a U-234/U-238 ratio much higher than the expected sea water value of 1·15. Although high, the ratios are generally quite uniform. These ratios indicate possible preferential uptake of U-234 over U-238.

Thorium concentrations are 0·5 ppm or less indicating little or no post-depositional uptake of thorium. Uptake of thorium, especially Th-230 would produce anomalously high ages.

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TABLE 1
AUSTRALIAN CARBONATE DATA

SAMPLE	U PPM	Th PPM	U-234 / U-238	U-234 DPHPG	Th-230 DPHPG	Th-230 / U-234	Th-232 / U-234	AGE
AS-1 OYSTER	1.87±0.07	0.05±0.01	1.25± 0.03	103.0 ± 3	53.3± 3	0.52±0.03	0.008	77,000
AS-2 OYSTER	0.63±0.04	0.01±0.02	1.20± 0.09	33.6 ± 2	21.2± 2	0.63±0.06	0.006	104,000
AS-3 OYSTER	2.30±0.09	0.33±0.04	1.24± 0.03	126.0 ± 4	75.3± 3	0.60±0.03	0.039	95,000
AS-4 OYSTER	0.30±0.03	0.19±0.06	1.13± 0.04	14.9 ± 2	9.75± 1	0.65±0.10	0.182	112,000
AS-5 OYSTER	1.20±0.07	0.29±0.03	1.22± 0.06	65.1 ± 3	40.4 ± 2	0.62±0.04	0.067	101,000
AS-6 CLAM *Neotrogonia margaritacea*	7.61±0.30	0.34±0.06	1.29± 0.03	436.0 ± 15	309.0 ±10	0.71±0.03	0.012	125,000
AS-7 CLAM *Anadara trapezia*	9.73±0.50	0.16±0.09	1.37± 0.03	591.0 ± 10	379.0 ±65	0.64±0.11	0.004	105,000
AS-8 CLAM *Anadara trapezia*	20.50±2.00	0.55±0.06	1.27±0.02	1155.0± 100	669.0 ±10	0.58±0.05	0.007	90,000
						Average Age		101,000

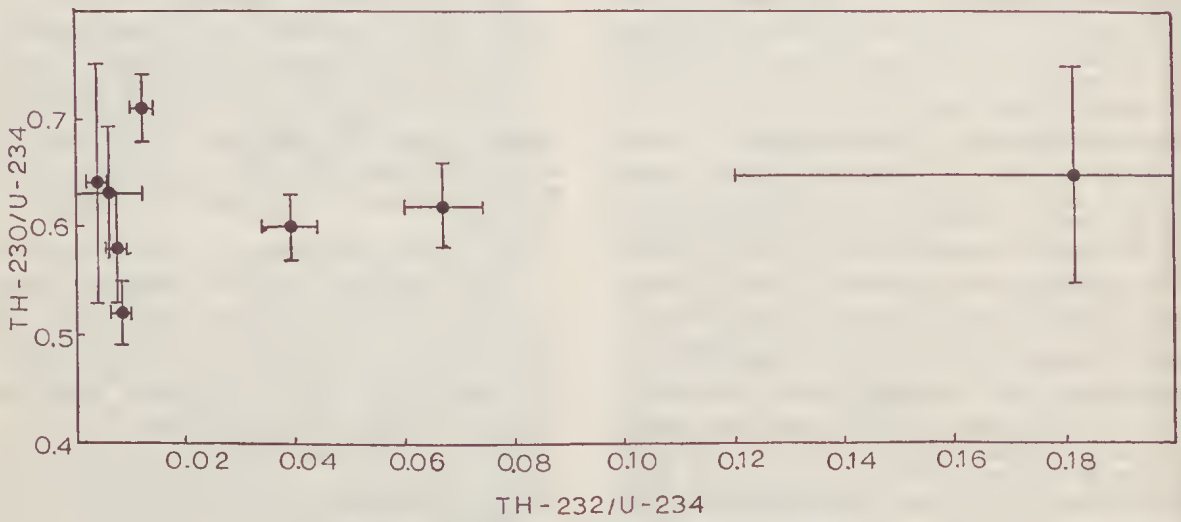

FIG. 1—Plot of Th-230/U-234 vx. Th-232/U-234.

The consistency of the Th-230/U-234 ratio, which is used to calculate the ages of the samples, is quite encouraging especially when dealing with a variety of shells. Calculated ages range from 77,000 years to 125,000 years with an average age of 101,000 years. The age is considerably greater than the reported ^{14}C age of 28,800 years, but the overall consistency of our data gives support to its validity.

In order to check on possible thorium contamination we applied the isochron method as described by Osmond, Tanner & May (1970). Fig. 1 is a plot of Th-230/U-234 vx. Th-232/U-234. With all of the Th-234/U234 values except one less than 0·07 and the Th-230/U-234 values fairly consistent, any isochron through these points gives only a slightly lower age than the average age.

We conclude, therefore, that our age of 101,000 years is a reasonable value. The consistency of the data seems to rule out any thorium contamination and if any uranium was added to the system it was done soon after deposition, thus having little or no effect on the analysis. If uranium were added to the system more recently, the effect would be to yield apparent ages lower than the true ages.

REFERENCE

OSMOND, J. K., MAY, J. P. & TANNER, W. F., 1970. Age of the Cape Kennedy Barrier-and Lagoon Complex. *J. geophys. Res.* 75: 469-379.